The author begins with a brief account of the aims and purposes of geology and the preparation of geological maps and soil surveys. He then passes to a discussion of the soils, their origin and fertility; the climatic conditions affecting them; their mineral and chemical composition and physical characteristics; drainage and irrigation; mineral fertilizers; forests and woodlands and the associated geological features; orchards, gardens and vineyards; geological considerations concerning estates; mineral rights; house sites with reference to drainage and water supply; closing with a series of eleven chapters on the geological formations of the various ages as occurring in England, with especial reference to the subjects previously treated. It is remarked that a map of the surface soil alone gives but a very imperfect idea of the capabilities of the land. Further, that no actual map showing the distribution in detail of the surface soils over any extended area has as yet been published, the so-called soil maps of the United States and Germany being in reality subsoil maps with indications of the nature and depth of the soil at particular spots. A good subsoil map, showing the variations in the strata, "whether drifts or the more regularly stratified formations, will always indicate the general distribution of the surface soils."

The most original portion of the book is that contained in the closing eleven chapters, in which all the principal geological formations of the kingdom are considered with reference to their soils, mineral resources, drainage and general availability for economic purposes. In this respect the work is quite unique, and, though local in its application, contains matter of value to the general reader. Illustrations are numerous, although, as is customary in works from the English press, line sketches preponderate over the half-tone reproductions from photographs, such as are so pronounced a feature of American works.

Mr. Woodward, it will be recalled, is also the author of the "History of the Geological Society of London," and "The Geology of Water Supply."

GEORGE P. MERRILL

NOTES ON METEOROLOGY AND CLIMATOLOGY

EUROPEAN METEOROLOGY

EUROPEAN meteorologists have recently given much attention to aeronautical, dynamical and mountain meteorology and to atmospheric electricity. In aeronautical meteorology greatest attention is being given to wind structure and to detailed forecasts for aviators. Research in dynamical meteorology is now particularly directed towards finding the laws governing the connection between upper-air processes and the weather at the earth's surface, with a view toward increased accuracy and range of weather forecasts.

An important institution for the study of dynamic meteorology is the set of synoptic charts of the atmospheric conditions over Europe, prepared under the direction of Professor V. Bjerknes, of Leipzig, from the monthly international aerological observations. Professor Bjerknes is the author of the still unfinished great work on "Dynamic Meteorology and Hydrography" which is being prepared under the auspices of the Carnegie Institution of Washington. The volumes on statics and kinematics have already appeared; and two more on dynamics and thermodynamics are yet to come.

In mountain meteorology, the föhn, local whirls and the difference in temperature between mountains and the free air at equal elevations have recently been studied.

Concerning atmospheric electricity, Mr. F. Schindelhauer in a thorough work entitled, "Über die Electrizität der Niederschläge,"[1] has discussed the results of the registration of the electricity of precipitation at Potsdam, 1909 to 1911. The electricity of precipitation is thought to be from the splitting up of large drops (Lenard waterfall effect), from the influence of the charge of the air, or the result of friction with the electrified air (dirigible balloons are sometimes ignited from electricity thus generated). Dr. K. Kähler in an article entitled "Der Einfluss des Wetters auf die

[1] *Veröffentlichungen des Kön. Preussischen Met. Inst.*, 1913, No. 263.

Atmosphärische Electricität,"[2] has pointed out that although weather affects atmospheric electricity the effects of the latter on the former are unknown. Mr. Carl Störmer's expedition to Bossekop, February 28 to April 1, 1913, secured 636 pairs of simultaneous photographs of the aurora from points 27 kilometers apart, most of which are very satisfactory for computing with a large degree of accuracy the form, position and altitude of all the principal kinds of aurora. Prismatic and kinematic photographs were also taken. The full results will be published in considerable detail later.[3]

SOUTHERN HEMISPHERE SEASONAL CORRELATIONS

A CONTINUED article on this subject by Mr. R. C. Mossman, of the Argentine Meteorological Office, is now appearing in *Symons's Meteorological Magazine*.[4] Abnormal conditions in one "center of action"[5] are accompanied by abnormal weather in others, and often indicate future conditions at distant points—a fact now used successfully in seasonal forecasts in India. A pronounced feature of many correlations is their temporary character, this applying more particularly to pairs of stations not located in action centers. For instance, from 1876 to 1894 an excess of rainfall at Trinidad from April to September was generally followed by a deficiency in rainfall during the next six months at Azo, Argentine Republic. Little correlation is shown before or after the above period. Java rainfall from October to March, 1880 to 1909, was generally the reverse of Trinidad rainfall for the following six months. Thus an excess of rainfall at Java for the months October to March gave indication of an excess to follow at Azo one year later.

CHANGES OF CLIMATE IN THE SOUTHWEST

SUCH changes during historical time as indicated by tree rings and "climatic terraces" have recently received the attention of Messrs. A. E. Douglass[6] and Ellsworth Huntington.[7] Mr. Douglass found by a test extending over forty-three years that the radial thickness of the rings of the yellow pine of northern Arizona gives a measure of the rainfall in that region with an average accuracy of over 70 per cent. Through examination of the rings of 100 trees, of which five were measured to the number of 400 rings and two to 500, a 21-year and a 11.4-year variation, each amounting to 16 per cent. of the mean were found. Its plot derived from 492 years shows two maxima which correspond in time with two maxima of rainfall in the 50 years of records on the south California coast. These in turn match with the major and minor maxima in the temperature of that region for the same period. The larger maximum of the latter occurs at the time of the sun-spot minimum as averaged for 125 years. Mr. Huntington supports these and his own results from studies of tree rings with evidences from alluvial terraces (5 to 1,000 feet high) of the rather dry mountainous regions of the southwest. These terraces are ascribed to variations in stream erosion or lake level due to variations in rainfall. Mr. Huntington has discussed this subject fully in previous works ("Explorations in Turkestan" and "The Pulse of Asia") and intends soon to discuss it with regard to America.

[2] *Das Wetter*, Berlin, 1913, pp. 49–56, 128–133, 173–178.

[3] From *Nature*, London, 1913, Vol. 91, pp. 584–585 (with reproductions of some of the photographs). Also Meteorologische Zeitschrift, 1913, pp. 410–412.

[4] Vol. 48, pp. 2–6, 44–47, 82–85, 104–106, 119–124.

[5] By "center of action" is meant one of the more or less permanent cyclones or anticyclones in control of the atmospheric circulation over a large area—*e. g.*, the Iceland cyclone, the Azores anticyclone.

[6] "Pine Trees as Recorders of Variations in Rainfall," Astron. and Astrophys. Soc. of America. Abstract in *Bull. Int. Inst. of Agric.* and in *Quarterly Journal of the Royal Meteorological Society*, 1913, pp. 244–245.

[7] "The Shifting of the Climatic Zones as Illustrated in Mexico," *Bull. Am. Geogr. Soc.*, 1913, pp. 1–12; *Geogr. Journ.*, June, 1913; *Quarterly Journ. of the Roy. Met. Soc.*, 1913, pp. 245–246. "Secret of the Big Trees, Yosemite, Sequoia and General Grant National Parks," Pub. U. S. Dept. of the Interior, 1913, 24 pp., 14 figs.

CORONIUM

THE discovery of the new gas "coronium" in the solar atmosphere from observations taken during the total solar eclipse of April 17, 1912, as announced in the London *Daily Citizen,* August 5, 1913, marks a turning point in the search for this long-suspected gas. The periodic law of chemical elements, enunciated by Mendeléeff more than forty years ago, calls for this gas, giving it an atomic weight much less than that of hydrogen. From a study of the spectra of meteors and the aurora Dr. A. Wegener[8] has attempted to prove the existence of this gas (which he calls "geocoronium") in the earth's atmosphere. He concluded that at a height of about 70 kilometers, this gas becomes an appreciable percentage of the atmosphere; that it increases to equality with hydrogen at about 200 kilometers, and eventually becomes practically 100 per cent. at 400 or 500 kilometers altitude.[9] Beyond this he considers interplanetary and interstellar space filled with this light-transmitting gas, inconceivably thin, but thickening locally around the planets, stars and sun (solar corona). The actual chemical determination of the presence of this gas in our atmosphere will be difficult, for at sea-level it is present (hypothetically, after Wegener) in but 0.00058 volume per cent.

EXPLORATION OF THE INTERIOR OF GREENLAND

CAPTAIN KOCH and his three companions, who have just returned to Denmark from Greenland, were the first to accomplish the difficult feat of traversing Greenland at its widest part (lat. 72°). The head-blizzards first encountered and later the dazzling sunlight of the interior plateau correspond closely with the meteorological conditions encountered on the rather similar antarctic continent. Greenland was first crossed in 1888 by Nansen at latitude 64°; Captain Peary crossed the northwestern end three times, 1892–1895, and A. de Quervain crossed at latitude 68° in 1912. Long trips into the interior from the west coast were made in 1883 by Baron Nordenskiöld at 68°, and in 1886 by Captain Peary at 69°.

[8] "Untersuchungen über die Nature der obersten Atmosphärenschichten," *Physikalische Zeitschrift,* Leipzig, 1911, pp. 170–178, 214–222.

[9] Cf. W. J. Humphreys, "Distribution of the Gases in the Atmosphere," *Bull. Mt. Weather Obs.,* 1909, II., 2.

EARTHQUAKES AND RAINFALL

ALTHOUGH Ferdinand de Montessus de Ballore after a study of the rainfall conditions preceding 4,136 earthquakes, was unable to find any connection, Professor Omori has found an apparent relationship between the annual frequency of earthquakes at Tokyo and the amount of rainfall in northwestern Japan. The periods when earthquakes were infrequent but severe correspond in a striking manner with those when rainfall was deficient at Niigata and Akita on the Japan seacoast, while in years of maximum earthquake frequency at Tokyo, the amount of rain and snow falling in the north was much above the average.[10]

NOTES

THE great heat in the middle west this summer broke all previous records for that section, both in duration and degree. For instance, the temperature at St. Joseph, Mo., from June 14 until September 9 exceeded 90 degrees on all but fifteen days; on twenty-six days it exceeded 100 degrees and on ten days reached 104. The injurious effect of this heat spell was greatly accentuated by the general drought prevailing throughout the period.

DAILY wireless weather reports are being received at Melbourne from Dr. Mawson, in charge of the Australian Antarctic Expedition now exploring the coast of Antarctica.

PRINCE GALITZINE on July 18 became director of the Nicholas Central Physical Observatory, St. Petersburg, succeeding General M. Rykatchew, who retired.

DR. H. MOHN, director of the Meteorological Institute of Norway since its foundation in 1866, and professor of meteorology in the Uni-

[10] *Nature,* London, Vol. 91, p. 65.

versity of Christiania, has retired. Mr. Askel S. Steen succeeds him in these capacities.

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SPECIAL ARTICLES

RELIABILITY AND DISTRIBUTION OF GRADES

If we consider grades scientifically as a scale of measurements, two important questions arise: (1) How fine a scale of units is distinguishable, and (2) What proportion of persons will ordinarily fall under each unit?

First, let us examine the question as to the size of distinguishable steps. The answer to this question can be determined by the reliability with which marks can be assigned. Recent studies have revealed an exceedingly wide divergence in the grades assigned by different teachers to the same papers. Starch and Elliott[1] found that the grades assigned to two English papers by 142 teachers of English ranged in the case of one paper from 64 to 98 with a probable error of 4.0, and in the case of the other paper from 50 to 98, with a probable error of 4.8. This wide range is not due to the fact that these were language papers, since the grades of a mathematics paper assigned by 118 teachers of mathematics ranged from 28 to 92, with a probable error of 7.5 points.[2]

What bearing do these facts have upon the reliability of marks and how are we to explain such wide ranges of differences? Four major factors enter into the problem which, I believe, fully account for the situation: (1) Differences among the standards of different schools, (2) Differences among the standards of different teachers, (3) Differences in the relative values placed by different teachers upon various elements in a paper, and (4) Differences due to the pure inability to distinguish between closely allied degrees of merit.

How much of the variation is due to each factor? To determine the strength of the first factor we must find out the range of variation in the grades assigned by teachers in the same institution and departments instead of different institutions. To this end I obtained ten papers written in the final examination in freshman English at the University of Wisconsin, and had them graded independently by ten instructors of the various sections of freshman English. An effort is made by cooperation among the instructors concerned to have as much uniformity as possible in the conduct of these sections. The same final examination is given to all.

Table I. gives the marks assigned by each instructor to each paper. The first column contains the grades assigned by the teachers under whom the students took the course. Papers 6 and 10 were obtained from the class of one instructor and all the other papers from the class of another instructor. These ten

TABLE I

Papers	Instructors										Average	Mean Var.	Coefficient of Variability
	1	2	3	4	5	6	7	8	9	10			
1	85	86	88	85	75	80	88	87	85	87	84.6	2.8	.034
2	77	80	87	80	62	82	82	87	85	87	80.0	4.6	.057
3	74	78	78	75	69	84	91	83	79	80	79.1	4.4	.056
4	65	65	62	20	26	60	55	68	55	50	52.6	12.3	.233
5	68	82	78	82	64	88	85	86	78	80	79.1	5.7	.070
6	94	87	93	87	83	77	89	88	88	89	87.5	3.2	.036
7	88	90	95	87	79	85	96	91	87	89	88.7	2.6	.029
8	80	84	73	79	72	83	85	91	77	76	80.0	4.6	.058
9	70	70	68	50	44	65	75	81	79	79	68.1	9.1	.118
10	93	92	85	92	81	83	92	89	84	85	87.6	4.0	.045
Av.	79.4	81.4	79.8	73.7	65.5	78.7	83.8	85.1	79.7	80.2		5.3	.074

General average 78.7.

[1] D. Starch and E. C. Elliott, *School Review*, 20: 442–457.

[2] D. Starch and E. C. Elliott, *School Review*, 21: 254–259.